Report of the Review Committee on the Monopulse RF BPM System Upgrade Review

Held April 24, 1998 at Argonne National Laboratory

Committee members: Alan Fisher (SLAC), Thomas Shea (chairman, BNL), Om Singh (ANL)

Summary

The charge to the committee was presented by John Galayda in the form of six questions. Due to the completeness of the technical presentations that followed, the committee could easily answer these questions. The technical presentations included a system overview by Glenn Decker and a description of the upgrade plans by Bob Lill. Although the performance of the existing system compares well with those at other storage rings, the need for an upgrade is clear. This good performance is only attainable for certain bunch intensities and fill patterns. In two phases, the proposed upgrade would remove these operational constraints. The committee has concluded that the proposed upgrade path is reasonable. A comprehensive R & D plan incorporating beam-based studies was presented. In the following text, the committee has identified some minor topics that merit further study. Given a positive outcome of these studies, the desired goals of the upgrade can be achieved.

Charge 0: Is the specification of the desired improvement clear? Improvement of dynamic range to 40 dB. Reduction of preceding no-beam interval to 100ns.

In part, the dynamic range is being shifted from a configuration with too much headroom, to one that is more realistic. The need to reduce the no-beam interval to 100 ns is clear to the committee.

Charge 1: Do the matching filters make sense?

One committee member (Alan) analyzed the matching filter using Mathcad. The matching network does show a broad resonance centered close to the 352 MHz RF frequency, but the transfer impedance for this case peaks at 0.248 ohms as compared to 0.136 ohms for the button and cable alone. This would indicate a 5.2 dB signal enhancement as compared to the observed 8 dB enhancement. Given the uncertainties in the actual component values and parasitics, these results are probably consistent. The Mathcad model also shows a suitably fast transient response.

The removal of the broadband match provided by the existing attenuators and the

addition of the resonant matching network will modify the beam coupling impedance. The committee recommends that the effect of this impedance change on the stability of bunch trains be analyzed before the entire system is upgraded.

Charge 2: Are they compatible with alternatives for Phase II?

In considering the bandpass filters and all other components for Phase II, the committee notes that the presentation described the performance primarily at the center of the band and not on the skirts, where there will be significant reflections between system components. The goal of a 60-dB roundtrip return loss will be hard to meet with a filter that reflects power on the skirts. The transient response will be affected by these reflections and should be observed in prototype tests with various filters. Although individual components must be specified in the frequency domain, the transient response of the integrated system must be considered, making specification difficult. The transversal filters would provide a better broadband match than the simpler bandpass filters. It is noted that this type of specification is common in RF position monitor systems and that APS personnel have dealt with it during development of the original system.

Charge 3: Any additional alternatives for Phase II?

The phased approach that was presented is reasonable and conservative.
The following options are probably less conservative

1. The addition of very narrowband filters would lead to a CW signal. Although the transient effects due to fill pattern could be dramatically reduced, this configuration would eliminate individual bunch measurement capability. The dynamic range at the receiver would depend on the total circulating current rather than the bunch train current.
2. Broadband amplifiers at an appropriate point in the signal processing chain could adjust the dynamic range and provide a reasonable match. In order to avoid harming the current performance, noise performance would have to be carefully analyzed and a calibration scheme would have to be developed.

Although these options have some disadvantages, the committee recommends that they be briefly investigated and compared to the proposed plan.

Charge 4: Are R&D plans for Phase II sensible?

The plan to evaluate several implementations with beam-based studies is sensible. This approach to qualification testing is the only realistic way to assure the desired high performance.

Charge 5: Do you think we can meet the specification?

Yes.

Other issues

It was suggested during the presentation that the signal from the matching network could be used as a trigger source. However, this technique would lead to a trigger time that varies with intensity, and jumps one RF period at various points during the signal decay.

The new matching networks will be installed upstream of the thermally isolating, silicon dioxide cables. This will require attention by instrumentation personnel during vacuum bakeouts.